What is claimed is:

1. An electromechanically active material comprising:

a perovskite compound of the formula, $(Na_{1/2}Bi_{1/2})_{1-x}M_x (Ti_{1-y}M'_y)O_{3\pm z}$,

where M is one or more of Ca, Sr, Ba, Pb, Y, La, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu; and M' is one or more of Zr, Hf, Sn, Ge, Mg, Zn, Al, Sc, Ga, Nb, Mo, Sb, Ta, W, Cr, Mn, Fe, Co and Ni, and $0.01 < x < 0.3$, and $0.01 < y < 0.3$, and $z < 0.1$

2. An electromechanically active material comprising:

a perovskite compound of the formula, $(Na_{1/2}Bi_{1/2})_{1-x}M_x (Ti_{1-y}M'_y)O_{3\pm z}$,

where M is one or more of Ca, Sr, Ba, and Pb; and M' is one or more of Zr, Hf, and Sn, and $0.01 < x < 0.3$, and $0.01 < y < 0.2$, and $z < 0.1$.

3. An electromechanically active material comprising:

a perovskite compound of the formula, $(Na_{1/2}Bi_{1/2})_{1-x}Ba_x (Ti_{1-y}M'_y)O_{3\pm z}$,

where M' is one or more of Zr and Hf, and $0.01 < x < 0.2$, $0.01 < y < 0.1$, and $z < 0.1$

4. The material of claim 1, 2 or 3, wherein the material is selected from the group consisting of single crystals, textured polycrystalline materials, and polycrystalline materials.

5. The material of claim 4 wherein the material is in the form of a rod, fiber, ribbon, or sheet.

6. The material of claim 4, wherein the material is a polycrystalline material.

7. The actuator of claim 1, 2, or 3, wherein the material is a piezoelectric

material.

8. The actuator of claim 1, 2, or 3, wherein the material is an electrostrictive material with an electric field-induced strain greater than about 0.1% at a field less than 60 kV/cm.

9. The actuator of claim 1, 2, or 3, wherein the material is an electrostrictive material with an electric field-induced strain greater than about 0.2% at a field less than 60 kV/cm.

10. The actuator of claim 1, 2, or 3, wherein the material is an electrostrictive material with an electric field-induced strain up to about 0.45% at a field less than 60 kV/cm.

11. The actuator of claim 1, 2, or 3, wherein the material exhibits a field-forced phase transition.

12. The material of claim 1, 2, or 3, wherein the material exhibits both piezoelectric properties and a field-forced phase transition.

13. The material of claim 1, 2 or 3, wherein the parameters α, β and γ are selected such that the perovskite phase has a rhombohedral crystal symmetry.

14. The material of claim 1, 2 or 3, wherein parameters α, β and γ are selected such that the perovskite phase has a tetragonal crystal symmetry.

15. An electromechanically active material comprising:

a single crystal perovskite material of the formula, $M_{\alpha} Bi_{\beta}M'_{\gamma}M''_{\delta}O_{3\pm z}$,

where M is one or more of Na, K, Rb and Cs; M' is one or more of Ca, Sr, Ba, Pb, Y, La, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu; and M" is one or more of Ti, Zr, Hf, Sn, Ge, Mg, Zn, Al, Sc, Ga, Nb, Mo, Sb, Ta, W, Cr, Mn, Fe, Co and Ni;

where $z \leq 0.1$; $0.9 \leq \delta \leq 1.1$; α, β and γ are greater than zero; and $(\alpha + \beta + \gamma)$ is in the range of about 0.75 to 1.1.

16. An electromechanically active material comprising:

a perovskite material of the formula, $Na_{\omega}M_{\alpha}Bi_{\beta}M'_{\gamma}M''_{\delta}O_{3\pm z}$,

where M is one or more of K, Rb and Cs; M' is one or more of Ca, Sr, Ba, Pb, Y, La, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu; M" is one or more of Ti, Zr, Hf, Sn, Ge, Mg, Zn, Al, Sc, Ga, Nb, Mo, Sb, Ta, W, Cr, Mn, Fe, Co and Ni;

where $z \leq 0.1$; $0.9 \leq \delta \leq 1.1$; α, β, γ and ω are greater than zero; and $(\alpha + \beta + \gamma + \omega)$ is in the range of about 0.75 to 1.1.

17. The material of claim 16, wherein the material is selected from the group consisting of single crystalline materials, textured crystalline materials, and polycrystalline materials.

18. The material of claim 15 or 16, wherein the material is in the form of a rod, fiber, ribbon, or sheet.

19. The material of claim 14, wherein $(\alpha+\beta+\gamma)$ is in the range of about 0.75 to 0.95.

20. The material of claim 15 or 16, wherein perovskite material has a d_{33} value of greater than 200 pC/N.

21. The material of claim 15 or 16, wherein the material exhibits a strain of greater than 0.15%.

22. The material of claim 15 or 16, wherein the material exhibits a low hysteresis of actuation.

23. The material of claim 16, wherein M comprises K.

24. The material of claim 15 or 16, wherein the material is a single crystallite and the crystallite is a faceted crystal having a selected crystalline plane exposed.

25. The piezoelectric material of claim 24, wherein the exposed plane is the {100} plane of the corresponding cubic phase.

26. The piezoelectric material of claim 15 or 16, wherein the parameters α, β and γ are selected such that the perovskite phase has a rhombohedral crystal symmetry.

27. The piezoelectric material of claim 15 or 16, wherein parameters α, β and γ are selected such that the perovskite phase has a tetragonal crystal symmetry.

28. The piezoelectric material of claim 26, wherein parameters α, β and γ are selected such that the piezoelectric material lies near a morphotropic phase boundary or point.

29. The piezoelectric material of claim 27, wherein parameters α, β and γ are selected such that the piezoelectric material lies near a morphotropic phase boundary or point.

30. An electromechanically active material comprising:

a perovskite material having tetragonal crystal symmetry of the formula,

$M_\alpha Bi_\beta M'_\gamma M''_\delta O_{3\pm z}$,

where M is one or more of Na, K, Rb and Cs, wherein M comprises at least Na; M' is one or more of Ca, Sr, Ba, Pb, Y, La, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu; M" is one or more of Ti, Zr, Hf, Sn, Ge, Mg, Zn, Al, Sc, Ga, Nb, Mo, Sb, Ta, W, Cr, Mn, Fe, Co and Ni;

where $z \leq 0.1$;

$\alpha + \beta + \gamma + \delta < 2.0$;

$\alpha < \beta$; and

$\beta < 0.5$.

31. The material of claim 30 wherein $0.32\ \beta < 0.5$.

32. An electromechanical actuator device, comprising:

an array of crystallographically textured crystals in a matrix, said array exhibiting texture with respect to at least one crystallographic axis, wherein the crystals comprise:

a perovskite material of the formula, $M_\alpha\ Bi_\beta M'_\gamma M''_\delta O_{3\pm z}$,

where M is one or more of Na, K, Rb and Cs; M' is one or more of Ca, Sr, Ba, Pb, Y, La, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu; and M" is one or more of Ti, Zr, Hf, Sn, Ge, Mg, Zn, Al, Sc, Ga, Nb, Mo, Sb, Ta, W, Cr, Mn, Fe, Co and Ni;

where $z \leq 0.1$; $0.9 \leq \delta \leq 1.1$; α, β and γ are greater than zero; and $(\alpha + \beta + \gamma)$ is in the range of about 0.75 to 1.1

33. The method of actuating a tetragonal phase perovskite piezoelectric, comprising:

providing a tetragonal phase perovskite single crystal; and

actuating the crystal by application of an electric field in a direction out of the spontaneous polarization direction of {100}.

34. The method of claim 33, wherein the crystal is actuated in the <111>⟩ or <110>⟩ directions of the corresponding cubic phase.

35. A method of preparing a crystallographically oriented array of crystals, comprising:

growing crystals or crystallites comprising an electromechanically active material under conditions which allow them to express a faceted morphology; and

aligning a set of facets and/or edges which is common to all of the crystals or crystallites against a surface or edge, thereby resulting in a crystallographically textured array of crystals.

36. The method of claim 35, wherein the crystal or crystallites comprises a lead-containing perovskite or perovskite relaxor compound.

37. The method of claim 35, wherein the crystals or crystallites are grown in a flux liquid.

38. The method of claim 35, wherein the crystal or crystallite comprises (Na, Bi, Ba)TiO_3 or (Na, K, Bi, Ba)TiO_3.

39. An electromechanical device, comprising:

an array of crystallographically textured crystals in a matrix, said array exhibiting texture with respect to at least one crystal axis.

40. The device of claim 39, wherein said device selected from the group consisting of sonar transducers, piezoelectric motors, surface acoustic wave devices, adaptive mirrors, valves, ultrasonic devices, passive and active structural composites, acoustic dampening composites, positioning devices for manufacturing and scanning probe microscopes, printer devices, and other suitable actuation applications.

41. An electromechnaical device, comprising:

at least one single crystal fiber comprising an electromechanically acitive material secured in an appropriate matrix.

42. The device of claim 41, wherein said device comprises passive and active structural dampening composites, active fiber composites, sonar transducers, ultrasonic devices, positioning devices, and other suitable actuation applications.

43. The material of claim 1, 2 or 3, wherein α, β, and γ are selected such that the single crystal is antiferroelectric prior to the application of an electric field, and such that under an applied electric field, the single crystal transforms to a ferroelectric

phase, said transformation being accompanied by a strain of at least 0.1%.

44. The material of claim 43, wherein M=Na, M'=Ba, M"=Ti, and said transformation from antiferroelectric to ferroelectric phase is attained at a temperature of less than about 100°C.